For presentation at the AGU Spring Meeting, Boston, May 28-June 2, 2001

Theory of passive scalar fluctuations and transport caused by wave turbulence.

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Abstract:

We show that turbulent transport by random wave fields provides a new and important contribution to passive scalar transport in the ocean. The existence of the small parameter u_0/c_0, where u_0 and c_0 are the characteristic particle velocity and wave phase speed, respectively, allows essentially exact calculations starting from the Lagrangian formulation of particle motion. General expressions for the diffusion tensor and mean drift velocity are presented and applied to the case of baroclinic inertia gravity (BIG) waves, which is of particular importance at high latitudes. Also very interesting is the spectrum of passive scalar fluctuations which is found to display at least two distinct inertial-range power laws even when the wave velocity field has only one. The theory is supported by satellite measurements of Chlorophyll-a concentration whose spectra in certain ocean regions are dominated by BIG wave turbulence effects.